FEATURES OF RUSSIAN-AMERICAN PROGRAMS IN MANNED SPACE FLIGHTS

	Soyuz-Apollo	Mir-Shuttle	ISS
Program content	Vehicles docking and joint flight during a day	Arrangement of American research equipment on the Mir modules, long-term flight of American astronauts within Mir crew, repeated docking to Mir of Shuttle Orbiters for some crewmembers rotation, cargo delivery and return to the Earth.	Development of Russian Segment within International Station. Station joint exploitation with both parties transport means use
Type of Parties relations	Parity	Commercial	Parity with integrating role of NASA
Operations requiring interaction of specialists from both countries	Joint docking, both crew habitation in common atmosphere	Joint docking, both crew habitation in common atmosphere, long-term work of American astronaut within Mire crew on national science program and station maintenance	Development of ISS configuration, systems interaction , crew safety assurance

RUSSIAN AND USA INTERESTS IN MIR-SHUTTLE PROGRAM

Russian interests	USA interests
Commercial interests	Research program implementation aboard the Mir station including studies for results accounting in research program generation for ISS.
Experience of interaction with NASA in work on ISS development	Experience on long-term flights for its use in ISS program.
	Experience of interaction with Russian specialists in work on ISS development

KEY STRUCTURES OF PROJECT MANAGEMENT

USA

RUSSIA

Program Manager

Program Technical Director

STRUCTURES NASA

Management Group (Group 0)

The working groups

Cargo flow planning

Operations and systems integration

Crew safety assurance

Development of science programs and experiments execution

Crew training programs development

Medical support

...

STRUCTURES RSA

The principle of forming the working groups: selection of the most labor-intensive and critical areas of work.

WORKING GROUP STRUCTURE

Management Team (Team 0)

Co-chairman (NASA)	Co-chairman (RSC Energia)
NASA specialists	RSC Energia specialists

Tasks

Setting the tasks for the working groups.

Planning of the working group activities.

Coordination of the working group activities.

Approving decisions on the management-level issues.

Solving technical issues that have been left unsolved by the working groups

Working groups for specific fields of expertise

Co-chairman (NASA)	Co-chairman (RSC Energia)	....	Co-chairman (NASA)	Co-chairman (RSC Energia, CTC, RSA)
Specialists from NASA and some other organizations	Specialists from RSC Energia and some other organizations	....	Specialists from NASA and some other organizations	Specialists from RSC Energia and some other organizations

Working group activities in the specified field

The lower the level at which a decision is formulated, the higher its quality.

Clarification:

The approval of a decision can take place at any level, ranging from a head of a working group to the management of the agencies. The best option is when the decision is formulated at the level of the people who actually do the work and can consider all the possible options in detail.

Conclusion:

A continuous working contact is required not only between the working groups but at the level of the specialists from each side who actually do the work as well.

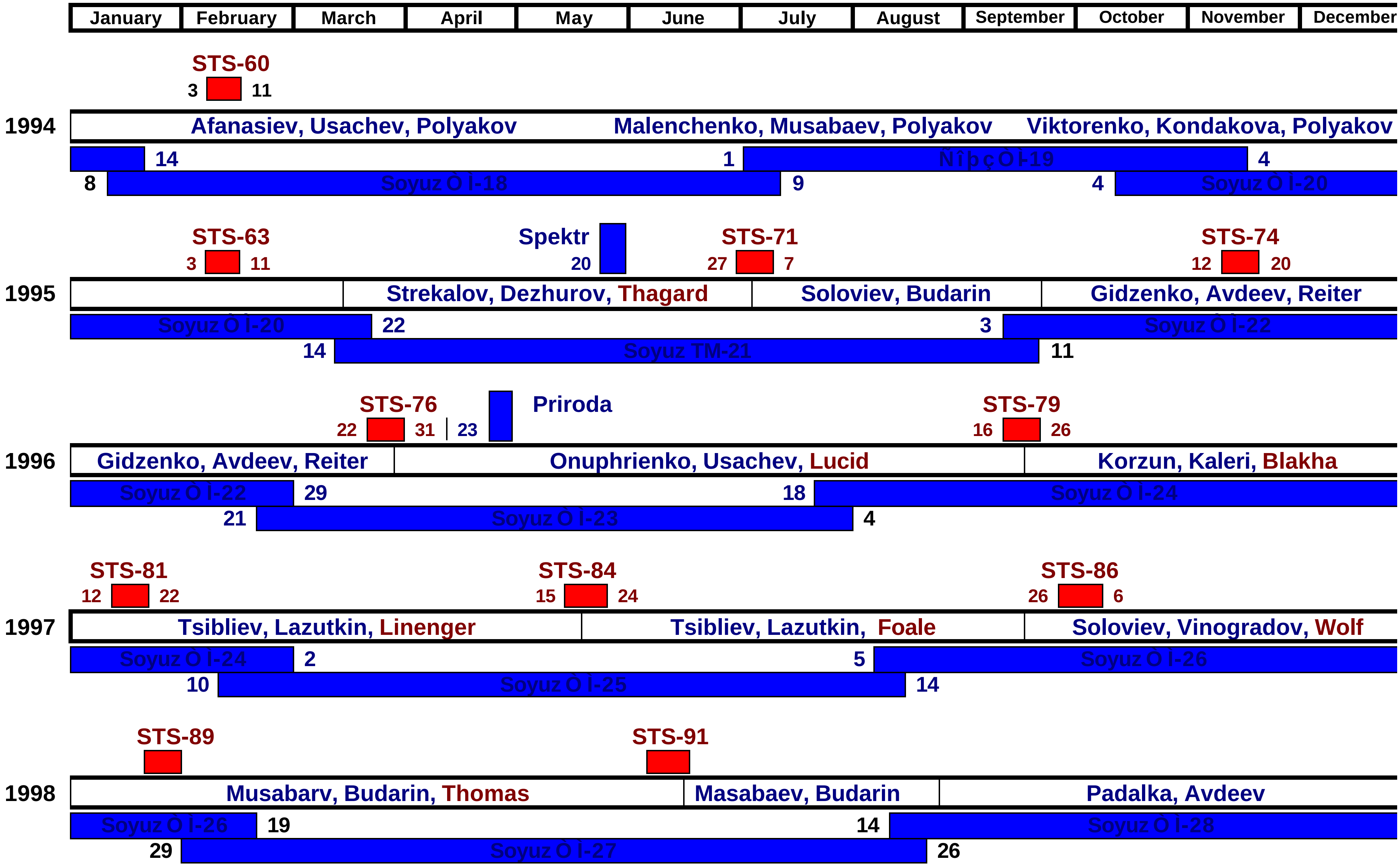
If the level at which a decision is formulated is raised, this, as a rule, means:

1. Insufficient competence of specialists who actually do the work.

Problems in the hierachical structure of one of the sides, when a specialist who actually does the work prefers, for some reason, that a difficult decision be proposed at a higher level.

Rocket&Space Corporation ENERGIA

MIR-SHUTTLE FLIGHT PROGRAM



SHUTTLE MISSION OBJECTIVES ACROSS MIR/SHUTTLE PROGRAM

Date	STS	Prime Objectives		Crew Rotation and Flights
3.2.94	60	Study of astronauts preflight training methods. Development test of flight operations by the first Russian cosmonaut.	Performance of Scientific program. Delivery of experiment hardware. Return of experiment results.	Krikalev flight
3.2.95	63	Shuttle rendezvous with Mir Station to a distance of 10 km. Test of interaction between Mission Control Centers.		Titov flight
27.6.95	71	Shuttle docking to Kristal module. Rotation of Mir crews. Russian logistics.		Thagard return, rotation of Dezhurov and Strekalov with Soloviev and Budarin
12.11.95	74	Shuttle docking to Kristal module. Delivery of Docking Compartment to the Station. Delivery of solar arrays.		–
22.3.96	76	Shuttle docking to DC. Egress into space to install science hardware.		Lucid delivery
16.9.96	79	Shuttle docking to DC. Expedited delivery of repair equipment (BVK, BPA). Dynamic tests of the Shuttle and Mir in a stacked configuration.		Rotation of Lucid with Blakha
12.1.97	81	Shuttle docking to DC. Delivery of life support system.		Rotation of Blakha with Linenger
15.5.97	84	Shuttle docking to DC. Expedited delivery of Electron hardware. Delivery of life support system.		Rotation of Linenger with Foale. Kondakova flight
25.9.97	86	Shuttle docking to DC. Expedited delivery of repair equipment. (BNP, Salyut -5). First joint EVA from Shuttle.		Rotation of Foale with Wolf. Titov flight
22.1.98	89	Shuttle docking to DC. Expedited delivery of repair equipment. (BKV-3, TsVU). Delivery of life support system.		Rotation of Wolf with Thomas. Sharipov flight
2.6.98	91	Shuttle docking to DC. Delivery of life support system.		Thomas return. Rumin flight

SOME REAL DATA ON PROGRAM

NN	Name	Amount
1.	Total number of astronauts flown to the Mir station	7
2.	Total time of astronauts staying aboard the Mir station	942 days
3.	Maximal duration of flight aboard the Mir station reached by American astronauts (S. Lucid)	188 days
4.	Total mass of American equipment installed on the station modules	2 tons
5.	Total mass of cargoes delivered to the station by Shuttle (including the Docking Compartment and solar array)	22.9 tons
6.	Total mass of cargoes returned to the Earth by Shuttle	7.8 tons
7.	Number of EVA performed on the station with participation of American astronauts.	5
8.	Total time of American astronauts participation in EVA	26 hours

MAJOR FACTORS ENSURING PROGRAM SUCCESS

Specialists of both countries had greatest experience in manned flights.

Both countries had experience in International Programs

Both countries were interested in successful implementation of program

MAJOR FACTORS COMPLICATING IMPLEMENTATION OF JOINT PROGRAM

Types of Factors	Nature of Factors	Compensation Activities
Geographical	Countries were located on different continents, time zones did not coincide to a great extent, that complicated a bilateral information exchange and discussions.	For bilateral information exchange time “windows” before the beginning of work of the US specialists and after completion of the working day of Russian specialists were used, scheduled meetings in Moscow and Houston. One-way communications were used (fax, e-mail).
Technical-organizational	Different structure of documentation management, standards, measurement systems, etc.	System of joint documentation, joint standards, change record systems compatible with National systems were elaborated.
Psychological	Specialists of both countries often had different viewpoints on many technical and organizational issues, these viewpoints were based on great experience of each country, therefore, it was not easy to change viewpoints	Qualification of specialists from both countries allowed to understand the reasons, which these or those viewpoints were based on, and find joint solutions.

MAJOR ORGANIZATIONAL INTERFACES BETWEEN THE PARTIES FOR VARIOUS TYPES OF ACTIVITIES

	Type of Joint Activities and Operations	Interface	Interface Function
1.	Project Management	Activity of Joint Project Management Structure	Generation of task definition, information exchange, and decision making procedures
		Joint Documentation Structure	Development of joint documentation, coordinated national documentation and documentation exchange procedure.
		Joint Standards	Development of joint standards based on national standards with regard to tested technologies in each country
		Project Change Procedures	Joint procedures for change coordination by each country, having impact on other country activities.
		Crew Safety Assurance Procedure	Joint analysis of technical solutions and cargo flow, having impact on the joint crew safety.
2.	Flight Control	Activity of Joint Control Structure	Generation of planning, information exchange and decision making procedures
		Preparation of Flight Phase Reports	Information exchange and coordination of assessment statements

MAJOR TECHNICAL INTERFACES BETWEEN THE PARTIES FOR VARIOUS TYPES OF ACTIVITIES

	Type of Joint Activities and Operations	Interface	Interface Function
1	Accommodation of US hardware on the Station modules	Mechanical	Hardware layout in the Station compartments
		Electrical	Electric power supply to hardware
		Thermal	Thermal control of hardware
2.	Shuttle Docking to Mir	Mechanical	Selection of docking node, selection of docking parameters, calculation of the stack strength during dynamic operations.
		Gasodynamic	Solution of problem related to Shuttle plume impingement on Mir
		Atmosphere	Coordination of atmosphere parameters in combined compartments
3.	Us Astronaut Work as part of the Station Crew	Allocation of Crew Responsibilities	Crewmembers loading in various activities, including Station maintenance and research
		Daily Routine	Coordination of US astronaut daily routine with work schedule of other crewmembers
		Cargo Flow	Cargo definition to support US astronaut activities and science research

LOGIC FOR JUSTIFICATION OF OBJECTIVE NECESSITY FOR COMPROMISE SEARCH PROCEDURE

Availability of many organizational and technical interfaces between Parties

These interfaces shall be coordinated

Different options of interfaces organization are possible during the interfaces coordination

Interfaces options affect interests of each Party in different way (conflict of interests)

To take into account the interests of each Party the compromise search procedure is required

*** In the Mir-Shuttle program the conflict of interests never resulted in a conflict situation.**

COMPROMISE SEARCH PROCEDURE

	Compromise-search procedure	Remark
1	Determination of major interests (painful point) of each Party which are desirable to be observed	Major interests of Parties can be observed at the expense of decisions in other fields.
2	Selection of compromise option where interests of each Party are observed at the expense of minor interests.	
3	If this does not result in success, the options analysis is performed to balance losses of each Party in selection of compromise option.	Losses can be described as work period extension, additional expenditures for each Party, etc..

High professionalism of the participants makes it possible to devise an option, which will satisfy both sides.

MIR-SHUTTLE PROGRAM RESULTS IN THE INTERESTS OF ISS PROGRAM

Training on Parties interaction and joint procedures on the Earth	Processes testing and system integration in orbit
Project management organizational structure	Shuttle docking to Kristal and DC
Joint documentation maintenance structure	Special compartments (DC) delivery to the orbital station and arrangement on its structure
Training on Mission Control Centers interaction	Solar array delivery aboard the Shuttle
Crew training procedures in Russia and USA	Integration of control systems and dynamic operations
Procedures for equipment certifications and safety assurance	Integration of Life Support Systems on Shuttle and Mir
Medical personnel interaction at all phases of mission preparation	Integration of American science equipment in station modules
	Integration of communication systems

TOTAL RESULTS OF PROGRAM

- Both countries obtained experience of joint program development.

- Joint operation on the Mir station reduces risks associated with space station development and assembly.

- NASA has obtained experience of operation execution during the long-duration expeditions.

- The Human Life research program is implemented, microgravity and space environment are studied.